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# Evaluating the efficacy of electric fields on invasive crayfish based on observed behavioral changes

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**Introduction:** A contributing vector for the influx of invasive species into the Great Lakes has been via the system of channels and canals that make up the Chicago Area Waterway Systems (CAWS). This system provides a continuous artificial aquatic connection between the Great Lakes and Mississippi River Basins. Currently, the continued expansion of invasive carp species (*Hypophthalmichthys nobilis* & *molitrix*) has been slowed by a system of electric barriers operated by the U.S. Army Corp of Engineers. There is limited work on the effectiveness of this barrier against other invasives. In this study, observations were recorded for invasive/potential invasive invertebrates to gain insight into the efficacy of this control method for invasive crayfish species.

## Objectives

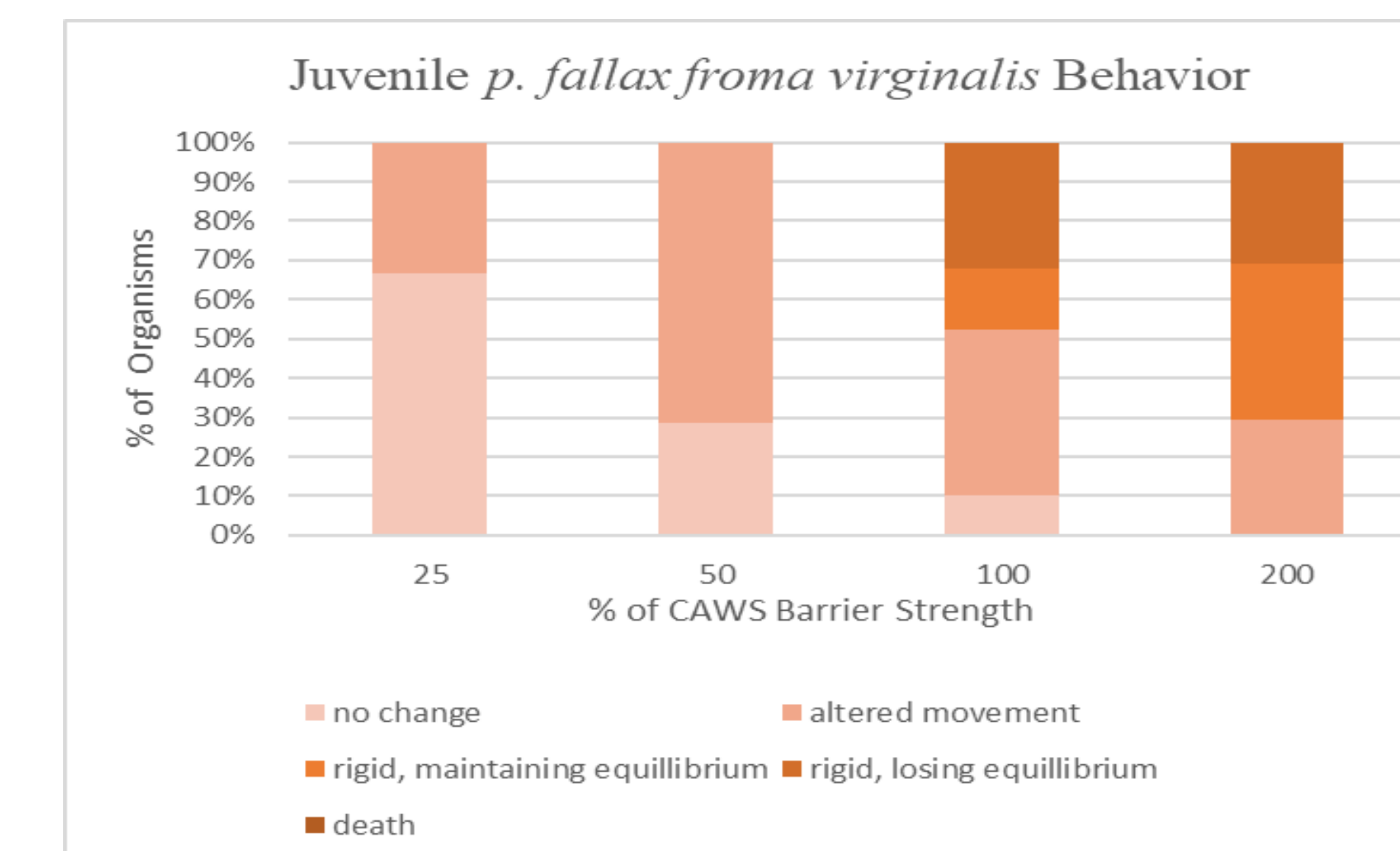
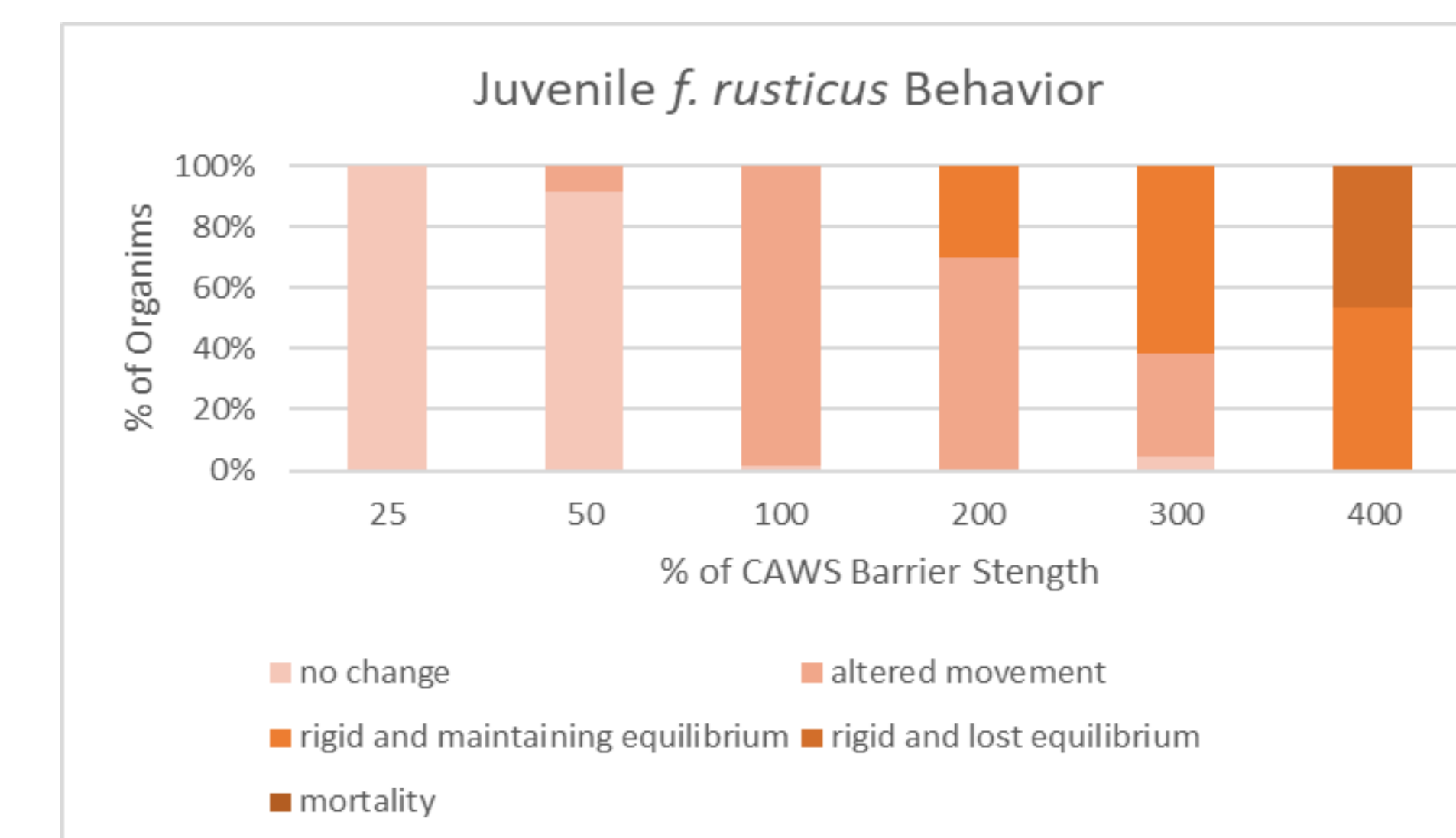
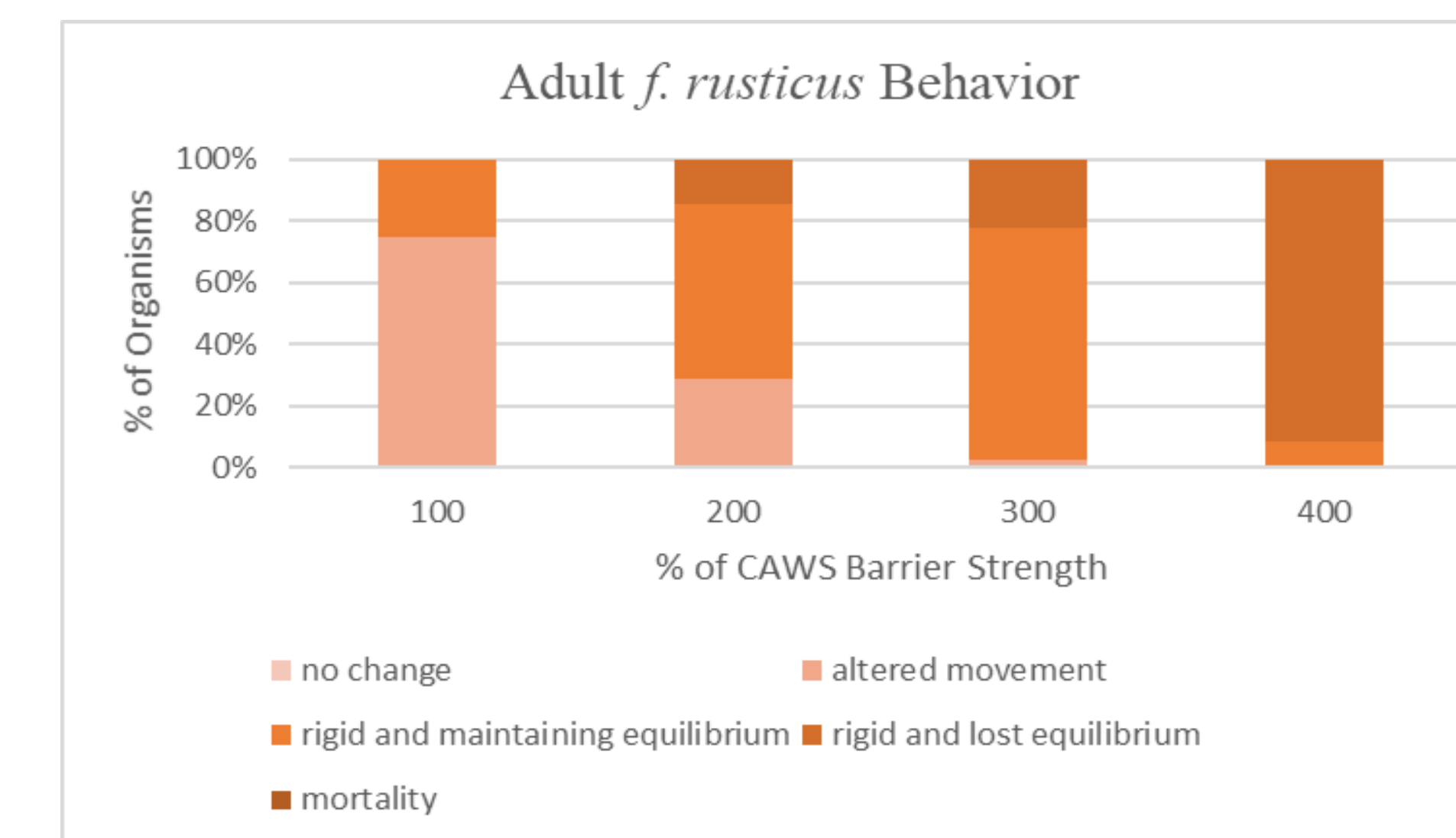
- Gauge the potential efficacy of electric barriers as a mechanism to control the spread of aquatic invasive invertebrates
- Measure the behavioral response and potential mortality of aquatic invasive organisms exposed to electric fields as varying voltages.

## Methodology

- The electric field was made utilizing a rectangular glass tank (122 cm long, 32 cm wide, 34 cm deep) and replicated the electric field strength and waveform present in CAWS electric barrier. To produce the current a modified electrofishing backunit, a power supply, and two steel electrodes placed at both ends of the tank attached to the electrofishing unit by jumper cables. (See Figure 1.)
- Each trial consisted of three phases: pre-stimulus, stimulus and post stimulus. During the trials behavior was recorded at the end of each minute and every 2.5 minute to observe physical response to a nonconductive rod. All organisms were kept for 24-hours to check for delayed mortality.
- The organisms were tested at 25%, 50%, 200%, 300%, and 400% of the electric barrier's field strength by changing voltage to 26, 53, 212, 318, and 424 V respectively while leaving all other parameters constant
- 2 species were utilized in these trials: Adult and juvenile rusty crayfish (*f. rusticus*) and Marmokrebs (*p. fallax froma virginalis*)

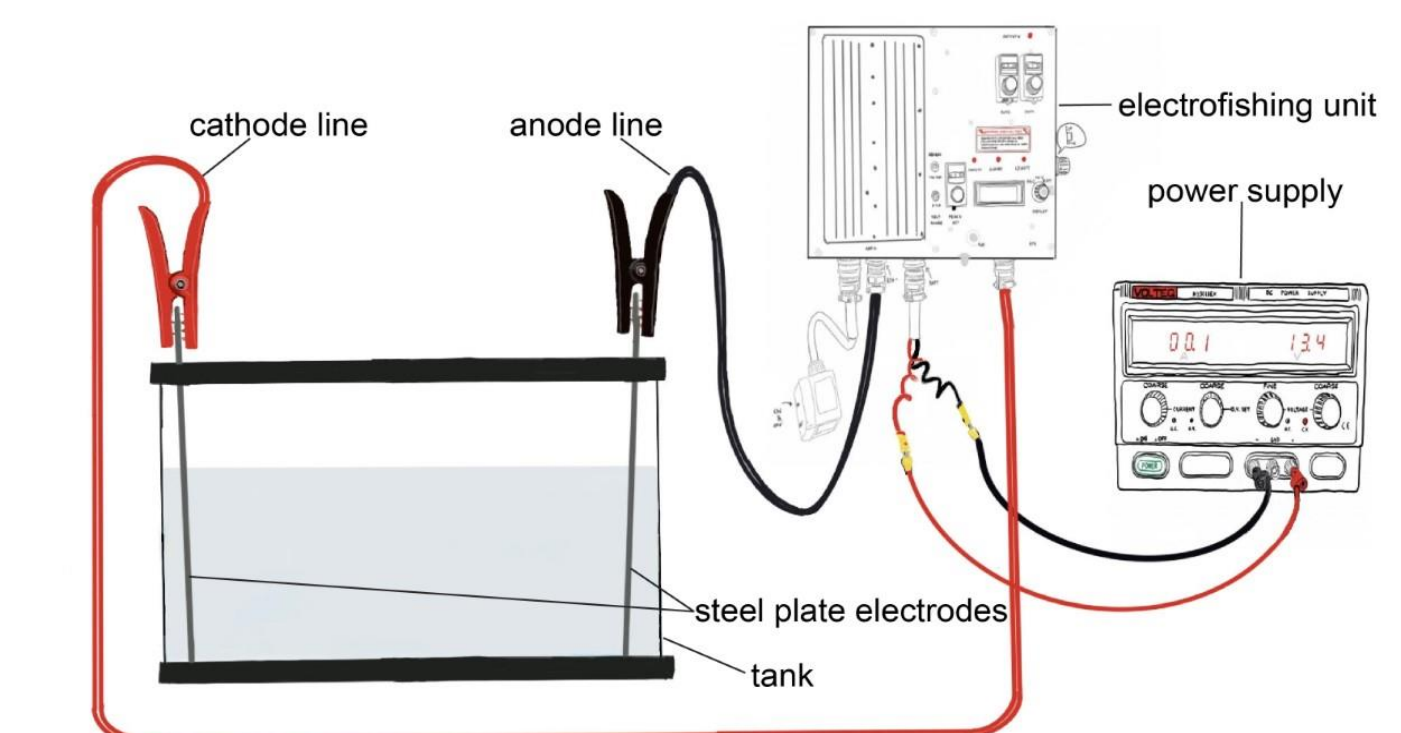
## Results & Behavioral Analysis

- Five distinct behavioral categories were used: **no change in behavior** – individual exhibits normal behavior; **altered movement** – individual exhibits difficulty in moving; **rigid and maintaining equilibrium** – body is rigid but stays upright and maintains equilibrium; **rigid and lost equilibrium** – body is rigid, no motor functions and organism is not maintaining itself in upright position; **mortality** – motor functions with no recovery, death.
- Each graph represents the summed total of beach behavioral category experienced by organisms during the 5-minute exposure at each voltage tested.
- This is represented as a percent of individuals who exhibited each behavioral response.
- Behavioral categories vary to account for differences in observable reactions to exposure.



## Additional Figures

Figure 1.



## Conclusion

- Efficacy of the CAWS electric barrier at it's current voltage of 106V may be insufficient for protection against the spread of these organisms
- Larger organisms are visibly more drastically affected by the electric field as the voltage increases suggesting a correlation between organism size and sensitivity to the electric field.
- Zero observed mortalities during the trial and 24 hours suggest minimal long-term effects. Additionally, research should be conducted to determine the effects of sustained exposure to an electric field
- Further studies should be conducted to determine the ability for paralyzed organisms to be transported by ship wakes and water currents past electric barriers